EDGE DETECTION BASED STROKE ADJUSTMENT
Arnold, et al.
Serial No. 10/816,582
Attorney's Docket No. 07844-636001

FIG. 1
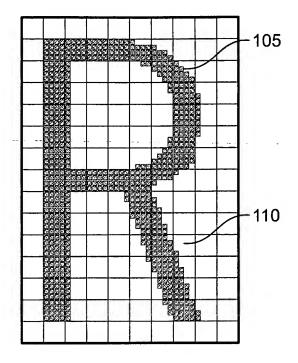

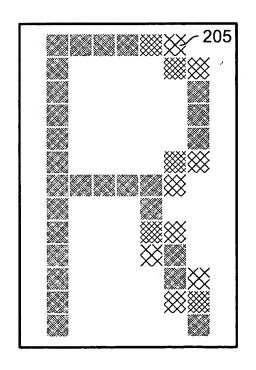**FIG. 2**

FIG. 3A

FIG. 3B

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FIG. 4A

FIG. 4B

FIG. 4C

500

505

Receive Glyph Having a Font Type
and a Size

510

Determine a Stem Width of the
Font Type

515

Calculate a Scaled Stem Width

520

Determine an Initial Adjustment
Value

522

Generate Bitmap

525

Detect Glyph's Stroke Edges

530

Calculate Length of Edge Passing
Through Device Pixels

535

Calculate a Final Adjustment
Value for Device Pixels

540

Calculate a Density for Device
Pixels Representing the Glyph

FIG. 5

FIG. 6A

FIG. 6B

FIG. 6C

FIG. 6D

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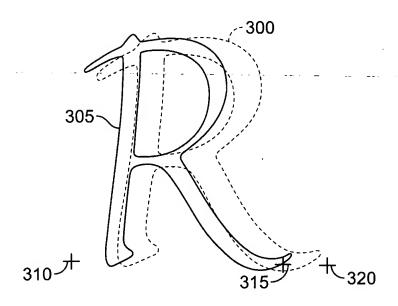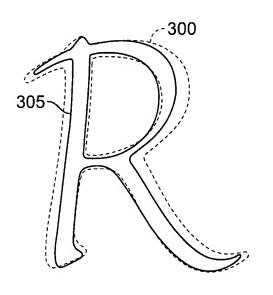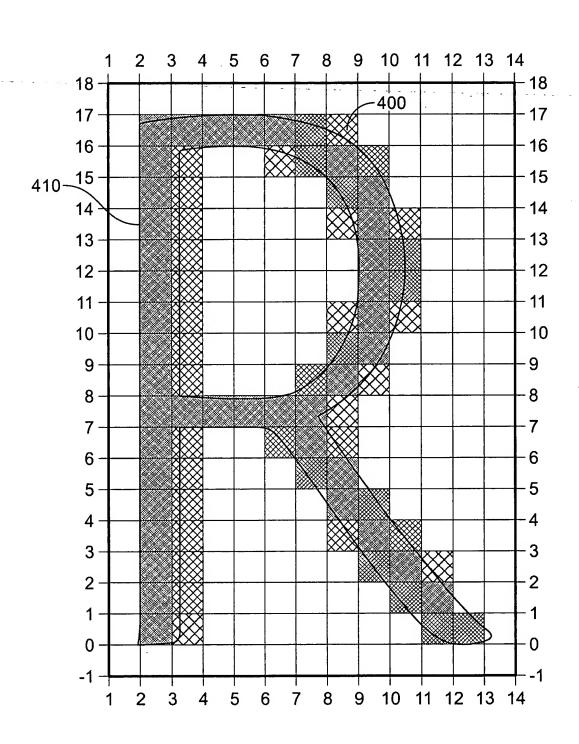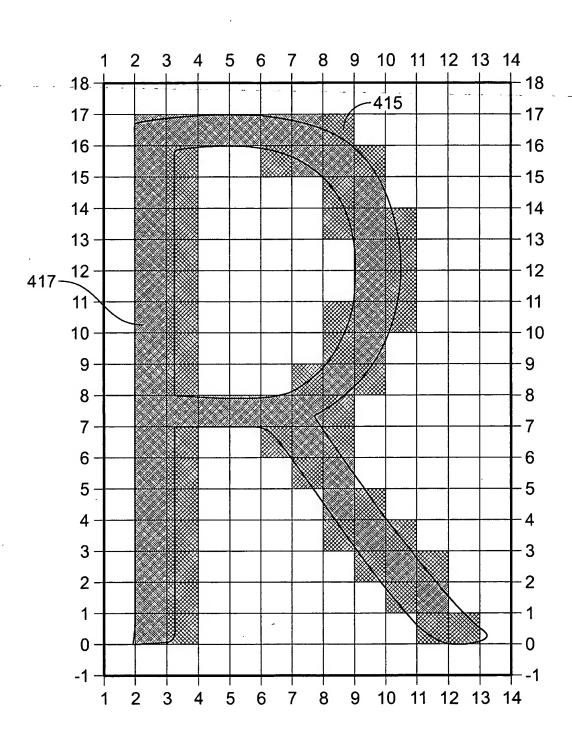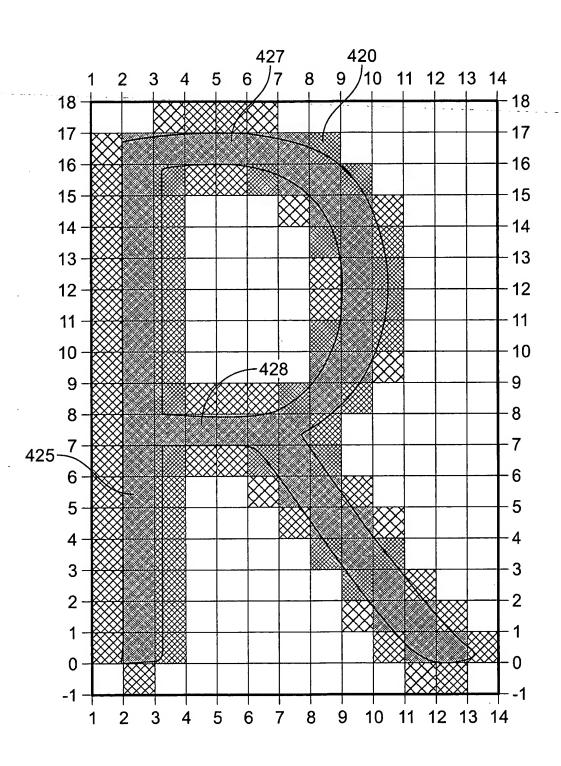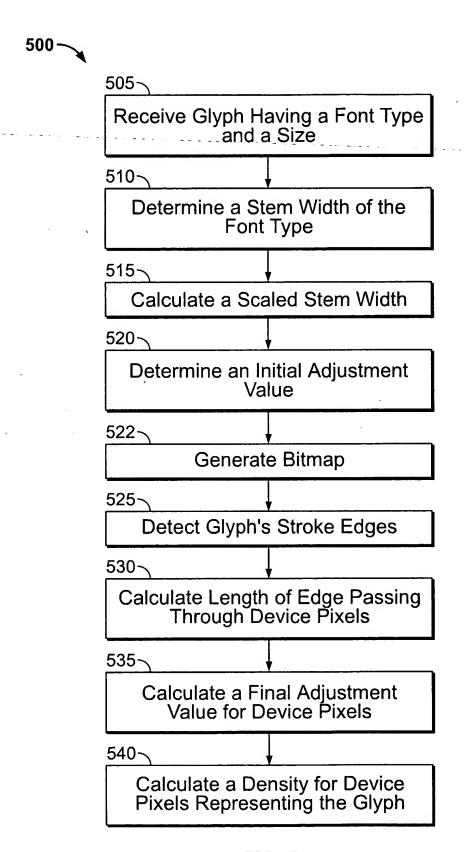Attorney's Docket No. 07844-636001

FIG. 7A

**Stem Adjustment
Type 1 Gray**

FIG. 7B

Stem Adjustment
Type 1 Sub Pixel Rendering

FIG. 7C

Font Type: Type 1 Gray Scale

Scaled Stem Width (1/16ths) 802	X Grid Ratio 804	Y Grid Ratio 806	Hint Grid Ratio 808	Hinting Policy 809	X Align. 810	Y Align. 812	X Offset Amt. 814	Y Offset Amt. 816	X Carry (y/n) 818	Y Carry (y/n) 820	Initial Adjustment Value (1/16ths) 822
0	4	4	4	Black Edge	4	4	0	1	1	1	4
1	4	4	4	Black Edge	4	4	0	1	1	1	4
2	4	4	4	Black Edge	4	4	0	1	1	1	4
3	4	4	4	Black Edge	4	4	0	1	1	1	4
4	4	4	4	Black Edge	4	4	0	1	1	1	4
5	8	8	8	Black Edge	8	8	0	1	1	1	4
6	8	8	8	Black Edge	8	8	0	1	1	1	4
7	8	8	8	Black Edge	8	8	0	1	1	1	4
8	8	8	8	Black Edge	8	8	0	1	1	1	4
9	8	8	8	Black Edge	8	8	0	1	1	1	4
10	8	8	8	Black Edge	8	8	0	1	1	1	4
11	4	4	4	Black Edge	4	4	1	1	1	0	4
12	4	4	4	Black Edge	4	4	1	1	1	0	4
13	8	8	8	Black Edge	8	8	1	1	1	1	3
14	8	8	8	Black Edge	8	8	1	1	1	1	3
15	8	8	8	Black Edge	8	8	1	1	1	1	3
16	8	8	8	Black Edge	8	8	1	1	1	1	3
17	8	8	8	Black Edge	8	8	1	1	1	1	2

800

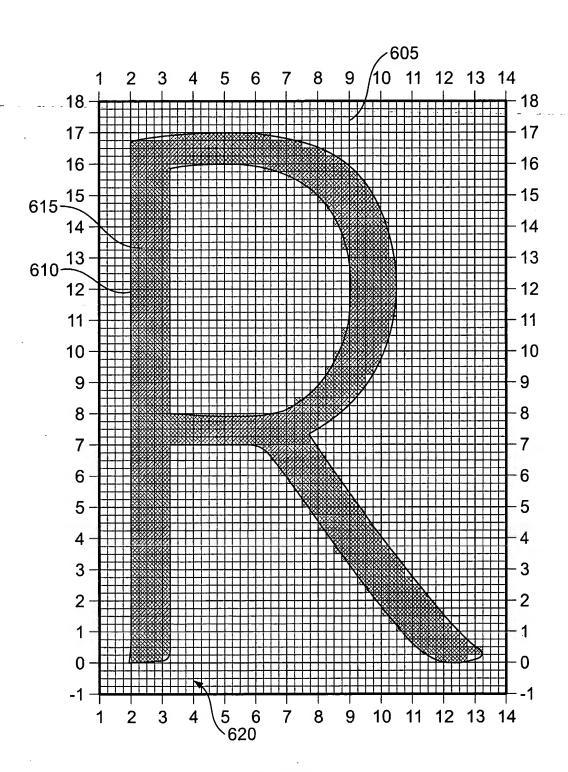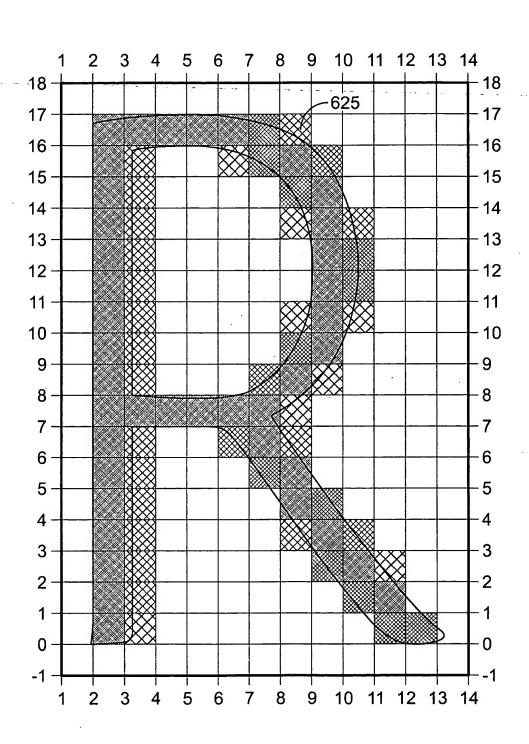**FIG. 8A-1**

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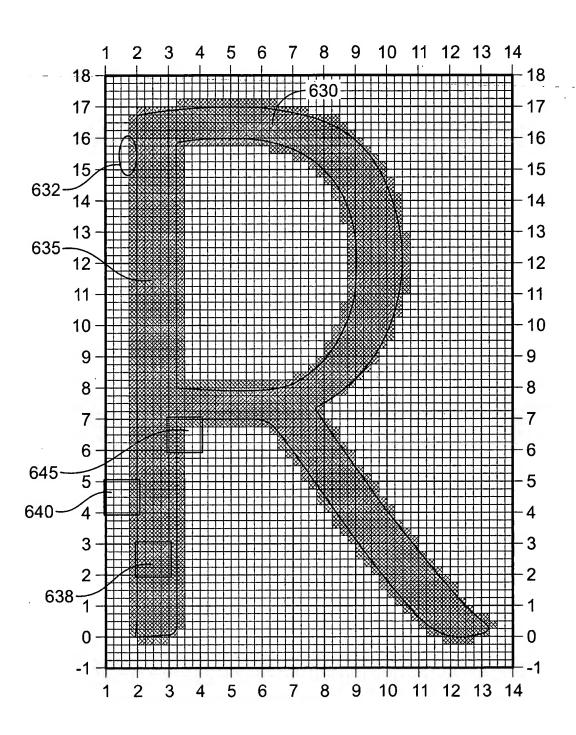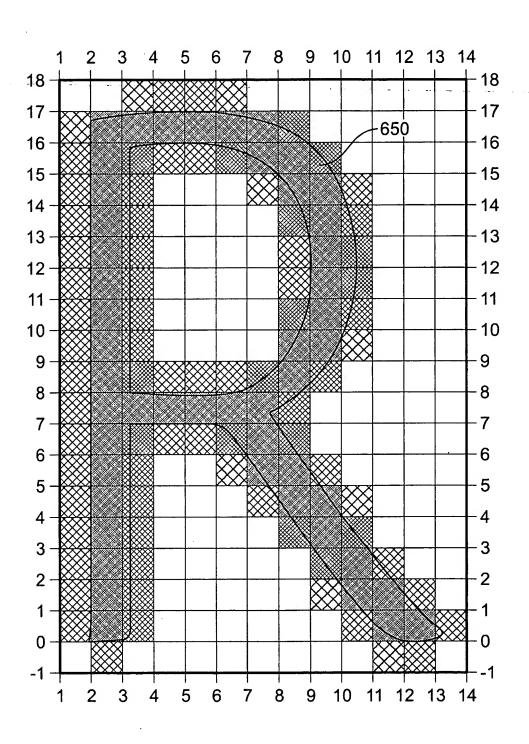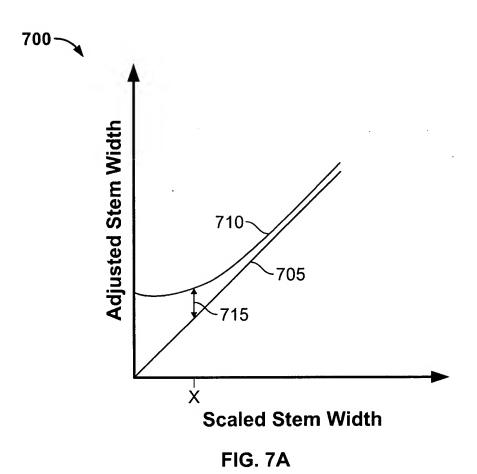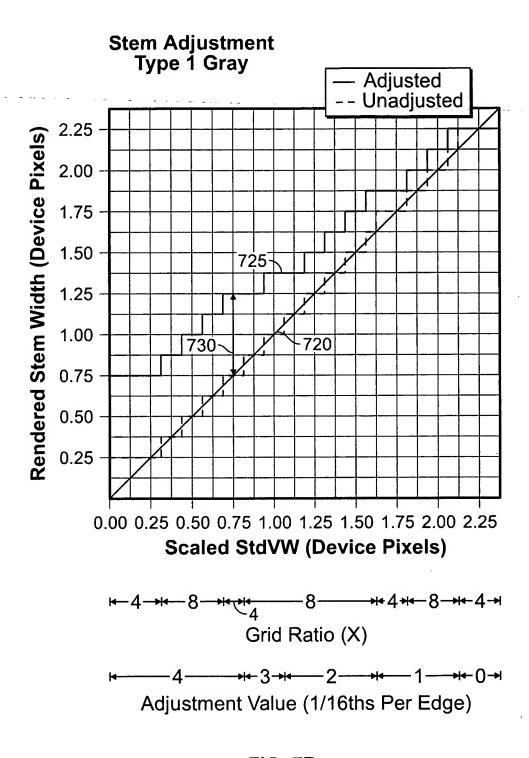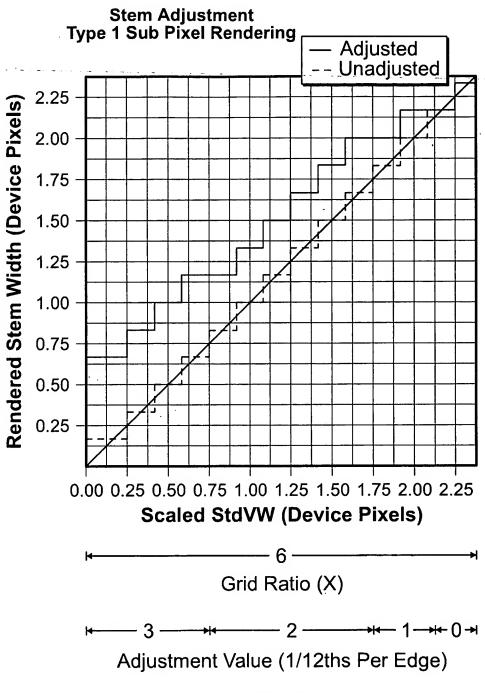Serial No. 10/816,582
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Scaled Stem Width (1/16ths)	X Grid Ratio	Y Grid Ratio	Hint Grid Ratio	Hinting Policy	X Align.	Y Align.	X Offset Amt.	Y Offset Amt.	X Carry (y/n)	Y Carry (y/n)	Initial Adjustment Value (1/16ths)
18	8	8	8	Black Edge	8	8	1	1	1	1	2
19	8	8	8	Black Edge	8	8	1	1	1	1	2
20	8	8	8	Black Edge	8	8	1	1	1	1	2
21	8	8	8	Black Edge	8	8	1	1	1	1	2
22	8	8	8	Black Edge	8	8	1	1	1	1	2
23	8	8	8	Black Edge	8	8	1	1	1	1	2
24	8	8	8	Black Edge	8	8	1	1	1	1	2
25	8	8	8	Black Edge	8	8	1	1	1	1	2
26	4	4	4	Black Edge	4	4	0	0	1	0	1
27	4	4	4	Black Edge	4	4	0	0	1	0	1
28	4	4	4	Black Edge	4	4	0	0	1	0	1
29	8	8	8	Black Edge	8	8	1	1	1	1	1
30	8	8	8	Black Edge	8	8	1	1	1	1	1
31	8	8	8	Black Edge	8	8	1	1	1	1	1
32	8	8	8	Black Edge	8	8	1	1	1	1	1
33	8	8	8	Black Edge	8	8	1	1	1	1	1
34	4	4	4	Black Edge	4	4	0	0	1	0	0
35	4	4	4	Black Edge	4	4	0	0	1	0	0
36	4	4	4	Black Edge	4	4	0	0	1	0	0
37	4	4	4	Black Edge	4	4	0	0	1	0	0

FIG. 8A-2

Font Type: Type 1 Gray Scale

Scaled Stem Width (1/16ths)	Asymmetric Adjusting (y/n)	Low Density	Low Initial Adjustment Value (1/16ths)	High Density	High Initial Adjustment Value (1/16ths)
	850	852	854	856	858
0	0	0	0	0	0
1	0	0	0	0	0
2	0	0	0	0	0
3	0	0	0	0	0
4	0	0	0	0	0
5	1	0	2	24	6
6	1	0	2	24	6
7	1	0	2	32	6
8	1	0	2	32	6
9	1	0	2	40	6
10	1	0	2	40	6
11	0	0	0	0	0
12	0	0	0	0	0
13	1	0	4	56	2
14	1	0	4	56	2
15	1	8	4	56	2
16	1	8	4	56	2
17	0	0	0	0	0
18	0	0	0	0	0
19	0	0	0	0	0
20	0	0	0	0	0

860

805

FIG. 8B-1

Scaled Stem Width (1/16ths)	Asymmetric Adjusting (y/n) 850	Low Density 852	Low Initial Adjustment Value (1/16ths) 854	High Density 856	High Initial Adjustment Value (1/16ths) 858
21	0	0	0	0	0
22	0	0	0	0	0
23	0	0	0	0	0
24	0	0	0	0	0
25	0	0	0	0	0
26	1	0	0	12	2
27	1	0	0	12	2
28	1	0	0	12	2
29	1	0	2	56	0
30	1	0	2	56	0
31	1	8	0	56	2
32	1	8	0	56	2
33	1	16	0	56	2
34	0	0	0	0	0
35	0	0	0	0	0
36	0	0	0	0	0
37	0	0	0	0	0

FIG. 8B-2

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Font Type: Type 1 Sub Pixel Rendering

Scaled Stem Width (1/6ths)	X Grid Ratio	Y Grid Ratio	Hint Grid Ratio	X Align.	Y Align.	X Offset Amt.	Y Offset Amt.	X Carry (y/n)	Y Carry (y/n)	Hinting Policy	Initial Adjustment Value (1/6ths)
0	6	6	6	1	6	0	0	1	0	Black Edge	3
1	6	6	6	1	6	0	0	1	0	Black Edge	3
2	6	6	6	1	6	0	0	1	0	Black Edge	3
3	6	6	6	1	6	0	0	1	0	Black Edge	3
4	6	6	6	1	6	0	0	1	0	Black Edge	3
5	6	6	6	1	6	0	0	1	0	Black Edge	2
6	6	6	6	1	6	0	0	1	0	Black Edge	2
7	6	6	6	1	6	0	0	1	0	Black Edge	2
8	6	6	6	1	6	0	0	1	0	Black Edge	2
9	6	6	6	1	6	0	0	1	0	Black Edge	2
10	6	6	6	1	6	0	0	1	0	Black Edge	2
11	6	6	6	1	6	0	0	1	0	Black Edge	1
12	6	6	6	1	6	0	0	1	0	Black Edge	1
13	6	6	6	1	6	0	0	1	0	Black Edge	0

840

FIG. 8C

Font Type: True Type Gray Scale

Scaled Stem Width (1/4ths)	X Grid Ratio	Y Grid Ratio	Hint Grid Ratio	X Align.	Y Align.	X Offset Amt.	Y Offset Amt.	X Carry (y/n)	Y Carry (y/n)	Hinting Policy	Initial Adjustment Value (1/4ths)
0	4	4	4	0	0	0	0	1	1	No Smoothing	4
1	4	4	4	0	0	0	0	1	1	No Smoothing	4
2	4	4	4	0	0	0	0	1	1	No Smoothing	4
3	4	4	4	0	0	0	0	1	1	No Smoothing	3
4	4	4	4	0	0	0	0	1	1	No Smoothing	2
5	4	4	4	0	0	0	0	1	1	No Smoothing	2
6	4	4	4	0	0	0	0	1	1	No Smoothing	1
7	4	4	4	0	0	0	0	1	1	No Smoothing	1
8	4	4	4	0	0	0	0	1	1	No Smoothing	1
9	4	4	4	0	0	0	0	1	1	No Smoothing	0

FIG. 8D

Font Type: True Type Sub Pixel Rendering

Scaled Stem Width (1/6ths)	X Grid Ratio	Y Grid Ratio	Hint Grid Ratio	X Align.	Y Align.	X Offset Amt.	Y Offset Amt.	X Carry (y/n)	Y Carry (y/n)	Hinting Policy	Initial Adjustment Value (1/6ths)
0	6	6	6	0	0	0	0	1	1	No Smoothing	3
1	6	6	6	0	0	0	0	1	1	No Smoothing	3
2	6	6	6	0	0	0	0	1	1	No Smoothing	3
3	6	6	6	0	0	0	0	1	1	No Smoothing	3
4	6	6	6	0	0	0	0	1	1	No Smoothing	3
5	6	6	6	0	0	0	0	1	1	No Smoothing	2
6	6	6	6	0	0	0	0	1	1	No Smoothing	2
7	6	6	6	0	0	0	0	1	1	No Smoothing	2
8	6	6	6	0	0	0	0	1	1	No Smoothing	2
9	6	6	6	0	0	0	0	1	1	No Smoothing	2
10	6	6	6	0	0	0	0	1	1	No Smoothing	2
11	6	6	6	0	0	0	0	1	1	No Smoothing	1
12	6	6	6	0	0	0	0	1	1	No Smoothing	1
13	6	6	6	0	0	0	0	1	1	No Smoothing	0

FIG. 8E

830 832 Font Type: True Type Gray Scale

Scaled Stem Width (1/8ths)	X Grid Ratio	Y Grid Ratio	Hint Grid Ratio	X Align.	Y Align.	X Offset Amt.	Y Offset Amt.	X Carry (y/n)	Y Carry (y/n)	Hinting Policy	Initial Adjustment Value (1/8ths)
0	8	2	8	1	4	0	0	1	0	Anisotropic	3
1	8	2	8	1	4	0	0	1	0	Anisotropic	3
2	8	2	8	1	4	0	0	1	0	Anisotropic	3
3	8	2	8	1	4	0	0	1	0	Anisotropic	3
4	8	2	8	1	4	0	0	1	0	Anisotropic	3
5	8	2	8	1	4	0	0	1	0	Anisotropic	2
6	8	2	8	1	4	0	0	1	0	Anisotropic	2
7	8	2	8	1	4	0	0	1	0	Anisotropic	2
8	8	2	8	1	4	0	0	1	0	Anisotropic	2
9	8	2	8	1	4	0	0	1	0	Anisotropic	2
10	8	2	8	1	4	0	0	1	0	Anisotropic	2
11	8	2	8	1	4	0	0	1	0	Anisotropic	1
12	8	2	8	1	4	0	0	1	0	Anisotropic	1
13	8	2	8	1	4	0	0	1	0	Anisotropic	1
14	8	2	8	1	4	0	0	1	0	Anisotropic	1
15	8	2	8	1	4	0	0	1	0	Anisotropic	1
16	8	2	8	1	4	0	0	1	0	Anisotropic	1
17	8	2	8	1	4	0	0	1	0	Anisotropic	1
18	8	2	8	1	4	0	0	1	0	Anisotropic	0

FIG. 8F

Font Type: True Type Sub Pixel Rendering

Scaled Stem Width (1/6ths)	X Grid Ratio	Y Grid Ratio	Hint Grid Ratio	X Align.	Y Align.	X Offset Amt.	Y Offset Amt.	X Carry (y/n)	Y Carry (y/n)	Hinting Policy	Initial Adjustment Value (1/6ths)
0	6	6	6	1	6	0	0	1	0	Anisotropic	3
1	6	6	6	1	6	0	0	1	0	Anisotropic	3
2	6	6	6	1	6	0	0	1	0	Anisotropic	3
3	6	6	6	1	6	0	0	1	0	Anisotropic	3
4	6	6	6	1	6	0	0	1	0	Anisotropic	3
5	6	6	6	1	6	0	0	1	0	Anisotropic	2
6	6	6	6	1	6	0	0	1	0	Anisotropic	2
7	6	6	6	1	6	0	0	1	0	Anisotropic	2
8	6	6	6	1	6	0	0	1	0	Anisotropic	2
9	6	6	6	1	6	0	0	1	0	Anisotropic	2
10	6	6	6	1	6	0	0	1	0	Anisotropic	2
11	6	6	6	1	6	0	0	1	0	Anisotropic	1
12	6	6	6	1	6	0	0	1	0	Anisotropic	1
13	6	6	6	1	6	0	0	1	0	Anisotropic	0

FIG. 8G
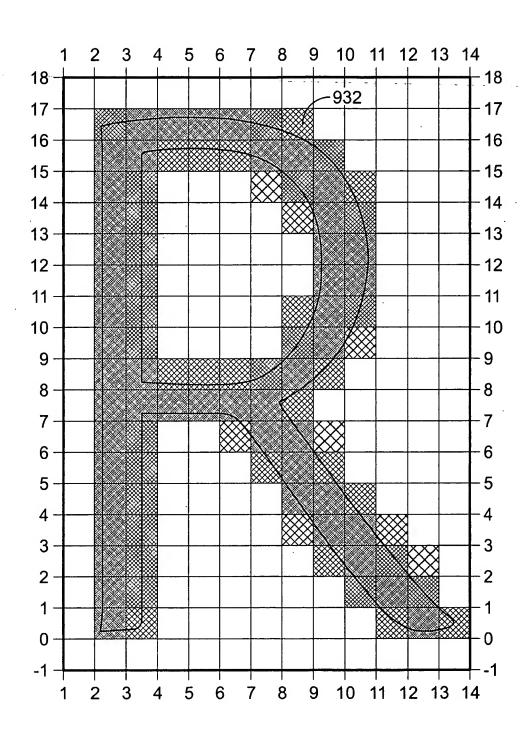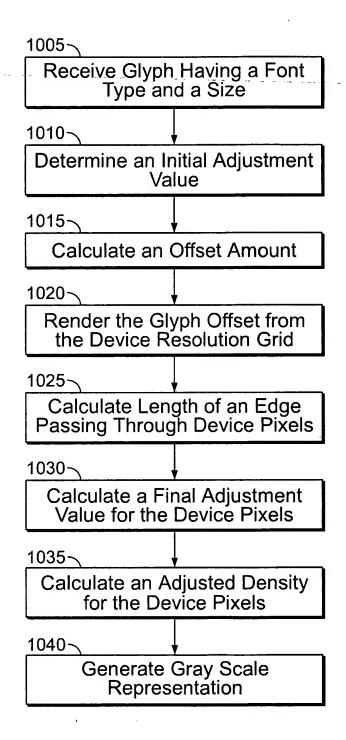
FIG. 9A

FIG. 9B

FIG. 9C

FIG. 9D

FIG. 9E

FIG. 9F

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FIG. 9G

1005 —
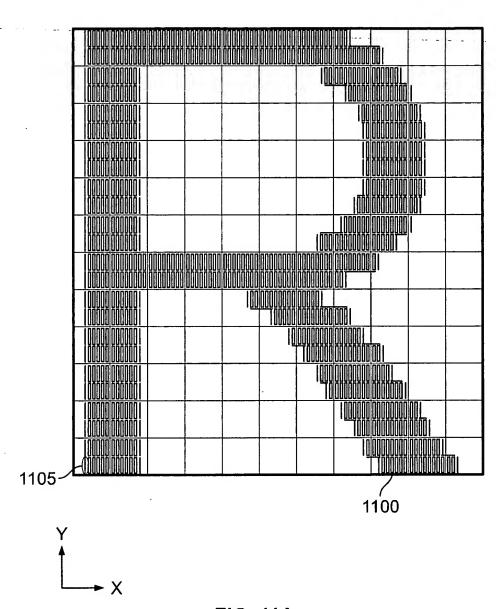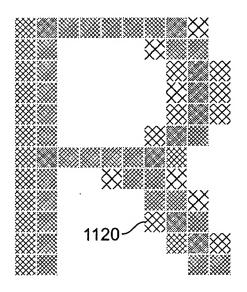Receive Glyph Having a Font Type and a Size

1010 —
Determine an Initial Adjustment Value

1015 —
Calculate an Offset Amount

1020 —
Render the Glyph Offset from the Device Resolution Grid

1025 —
Calculate Length of an Edge Passing Through Device Pixels

1030 —
Calculate a Final Adjustment Value for the Device Pixels

1035 —
Calculate an Adjusted Density for the Device Pixels

1040 —
Generate Gray Scale Representation

FIG. 10

1105

1100

Y

X

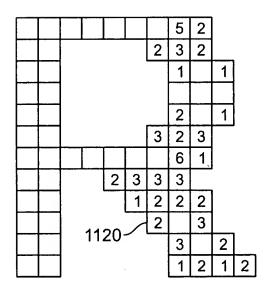FIG. 11A

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10	16	16	16	16	16	16	11	2		
10	12					2	13	14		
10	12					3	16	5		
10	12					2	16	6		
10	12					4	16	5		
10	12				3	14	13			
10	16	16	16	16	16	16	10	1		
10	12		2	13	13	3				
10	12		1	14	14	2				
10	12		4	16	11					
10	12		9	16	6					
10	12		1	14	15	2				

1120

FIG. 11B

1120

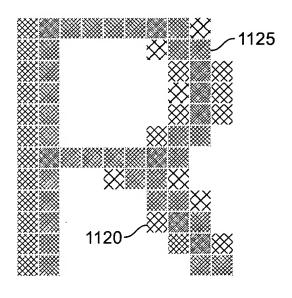## FIG. 11C

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1120

FIG. 11D

1120

FIG. 11E

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FIG. 11F

FIG. 11G

EDGE DETECTION BASED STROKE ADJUSTMENT
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Scaled Stem Width (16ths)	Grid Ratio	Alignment Offset	Darkening Amount (16ths Per Side)	Asymmetric Darkening				Phase Difference	Rasterized Stem Width (Bold Lines) and Darkening Amount (Light Lines), Showing Both Phases
				Low Density	Low Density Darkening Amount (16ths)	High Density	High Density Darkening Amount (16ths)		
1-4	4	0	4					1/4	
5,6	8	0	4	0	2	24	6	3/8	
7,8	8	0	4	0	2	32	6	1/4	
9,10	8	0	4	0	2	40	6	1/8	
11,12	4	1	4					1/4	
13,14	8	1	3	0	4	56	2	1/4	
15,16	8	1	3	8	4	56	2	3/8	
17,18	8	1	2					3/8	
19,20	8	1	2					1/2	
21,22	8	1	2					3/8	
23,24	8	1	2					1/4	
25	8	1	2					1/8	
26-28	4	0	1	0	0	12	2	1/8	
29,30	8	1	1	0	2	56	0	1/8	
31,32	8	1	1	8	0	56	2	1/8	
33	8	1	1	16	0	56	2	1/4	
34-37	4	0	0					1/4	

1210 1215 1205

FIG. 12